4 Excavation Construction Requirements

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CHAPTER FOUR: EXCAVATION CONSTRUCTION REQUIREMENTS

GENERAL PREPARATION

Prior to beginning excavation, grading, or embankment operations in any area, the following items are required to be completed:

1) Clearing and grubbing is conducted. This includes the removal of all perishable material such as tree roots, stumps, sod, weeds, agricultural debris, etc.

2) Check sections are taken and checked satisfactorily with those on the plans. On contracts with construction engineering, the Contractor is responsible for securing check sections. The method of checking original cross sections is outlined in the General Instructions to Field Employees.

3) After the previous items have been completed, the Contractor proceeds with scalping in areas where excavations are to be made, or embankments are to be placed. Another common term for scalping is stripping. Scalping is the removal of the upper 4 in. of the soils. Removal is necessary to insure that decayable vegetation is not incorporated into an embankment. Although 4 in. is the maximum depth, top soils containing large quantities of humus to a depth greater than 4 in. are removed until suitable materials are exposed. Scalping is completed to the limits the area where excavations are to be made or embankments are to be placed. The grading operations is inspected closely for unsuitable material. Roots and other large perishable objects are removed and stockpiled outside of the construction limits for later disposal.

4) All pronounced depressions left in the original ground surface by removal of objectionable material from within embankment limits are filled with acceptable material and compacted to the density required for the embankment. The upper 6 in. of the original ground is compacted with a roller weighing no less than 10 t, or with other approved compacting equipment.

5) The final step before embankment placement is proofrolling. This work is performed with a pneumatic tire roller (Figure 4-1) with a minimum tire size of 7:50 by 15 in accordance with Section **409.** Other approved equipment, such as a fully loaded tri-axle dump truck, may be substituted for the pheumatic tire roller. One or two complete coverages is required, as directed. Roller marks, irregularities, or failures are required to be corrected. This procedure also reveals all spongy and yielding materials which are not compacted. These materials within the proposed embankment are removed. The locations of spongy and yielding material may be detected visually.

During proofrolling, the pneumatic tire roller often leaves severe ruts in the grade indicating either yielding areas or unstable material. These locations may also be detected audibly. During proofrolling, the engine of the roller has a consistent sound if rolling solid grade. When an unstable area is encountered, the engine labors to pull the roller through the spongy area. After proofrolling has been completed and all soft or unstable areas have been corrected, the area is ready for placement of the new embankment.

Figure 4-1. Pneumatic Tire Roller

GENERAL REQUIREMENTS

Excavated material that is suitable for embankment construction is placed in the embankment before placing any borrow material. This means that ditches are excavated first, since much of common excavation is derived from ditch cuts. The construction of ditches first also provides drainage for the embankment area. The roadway embankments are maintained higher at the center to promote drainage of the roadway.

Once the ditches have been completed, the Contractor begins placement of temporary erosion control devices as soon as possible. Failure to do so may cause pollution to drainage ditches, streams, and rivers adjacent to the project. There are several different types of temporary erosion and sediment control devices. A list of the different types include:

1) Perimeter protection

2) Drainage barrier at swale

3) Slope protection – interceptor ditches and slope drains

4) Sediment control in side ditches – straw bale ditch check, riprap ditch check, ditch sediment trap, or culvert pipe protection

5) Sediment basin

6) Inlet protection – curb inlet protection and drop inlet protection

These erosion control features are maintained until permanent erosion control features are placed. The need for erosion control devices is determined in the planning stages of the project, and erosion control devices are outlined and detailed on the construction plans. Additional controls may be required to meet field conditions. The technician is responsible for ensuring that these devices are being maintained. Inspection of control devices is especially important during and after periods of rainfall which may cause damage to the devices. Sediment basins are required to be cleaned, dikes or dams reconstructed, and straw bales replaced, if damage has reduced the effectiveness of these devices.

During the construction of an embankment, each lift being placed has certain factors which are required to be considered:

1) Lifts are required to extend transversely over the entire embankment area between slope stakes. Doing this insures that the outside slopes of the embankment are compacted as

well as the middle of the embankment. The higher the fill, the more critical this becomes.

2) The fill width is required to be checked as the fill progresses. Failure to do so may cause fat or bellied slopes.

Fat slopes are slopes which contain excess material or exceed the planned slope. Bellied slopes are slopes that do not contain enough material and these slopes are detected by viewing the slopes longitudinally. Bellied slopes are required to be corrected as the embankment is being built. Sidecasting is avoided as a solution since this usually develops a fill slough or slide at a future date.

EQUIPMENT

Equipment required for placing embankment consists of four categories;

1) Hauling equipment

2) Spreading equipment

3) Compacting equipment

4) Moisture control equipment

HAULING

The method of hauling embankment material is determined by the Contractor and is based upon the following construction factors.

1) Type of material

2) Source of material

3) Conditions or obstacles between the source and area of placement

4) Availability of equipment

The equipment used for hauling includes:

1) Dump trucks

2) Earthmovers

3) Quarry trucks

Earthmovers (Figure 4-1) are the most frequently used means of hauling embankment material. There are various sizes and models of earthmovers. Earthmovers are used in excavating, hauling, and placement of soil materials that are adjacent to or on the contract. When common excavation is required to be hauled across a bridge structure or when borrow material is obtained from a remote source, dump trucks are used. Quarry trucks are used only in rock excavation.

Figure 4-1. Earthmover

SPREADING

Because embankments are to be constructed in uniform layers, spreading equipment is necessary. Placing uniform layers may be done with several types of equipment or groups of equipment. The most common are the motor grader and the bulldozer. If soil conditions are suitable, earthmovers may also be considered as spreading equipment. This is accomplished by the earthmover operator controlling the discharge of the materials in such a manner to create a uniform layer. Because soil conditions may change dramatically, the earthmover is not considered the only spreading device necessary.

Another method of leveling layers uses a sheepsfoot compactor with a blade (Figure 4-2). This equipment may be used instead of a motor grader. This is especially true on small grading projects.

Figure 4-2. Sheepsfoot Compactor with Blade

A piece of equipment that may also be used during the spreading operation is the disc (Figure 4-3). Although the disc does not level the soil, this equipment is helpful in creating a uniform layer. The disc is used for:

1) Breaking up lumps, slabs, and clods

2) Aerating material to remove excess moisture

3) Incorporating water to increase moisture

Figure 4-3. Disc

COMPACTING

Compacting equipment requirements vary from contract to contract. A list of the types of compactors which are most commonly used include:

1) Three wheel roller

2) Smooth drum vibrator roller

3) Vibratory tamping roller (Figure 4-4)

4) Static tamping roller or sheepsfoot

5) Crawler-tread equipment or bulldozer

6) Mechanical tamps or vibrators

Figure 4-4. Single Drum Vibratory Roller

The compactor to be used is determined by the Contractor and is dependent upon several factors:

1) Size of embankment

2) Type of materials being compacted

3) Conditions of materials being compacted

4) Availability of equipment

5) Contractor's preference

For placement of granular embankment material, three wheel and smooth drum vibrator rollers are preferred over tamping rollers. A dozer may be used in areas not accessible to conventional rollers, in building surcharges for peat excavation, or for rock embankments. Tamping vibratory rollers are preferable for shale embankment.

Figure 4-5. Hand Vibratory Roller

For placement of a clay soil embankment material, large slabs, lumps, or clods are required to be broken up before compacting. Breaking may be accomplished by disking, but often a sheepsfoot roller is required to break up clods and low moisture lumps.

The following chart is helpful in determining which compactors may be used for different materials.

Compactor Type	Material	Lift Depth
3 Wheel	all soils	8 in. maximum
Smooth Drum Vibratory	all soils	8 in. maximum
Tamping-Foot	soil or shale	Length of tamping foot
Crawler-Tread	rock	see Specifications
Crawler-Tread	aggregates*	6 in. maximum
Smooth Drum Vibratory	aggregates*	6 in. maximum
Mechanical Tamp or Vibratory	soils	6 in. maximum
Mechanical Tamp or Vibratory	aggregates	4 in. maximum

*Where impractical to perform density tests.

Whatever equipment is used for compacting, the goal is a uniform dense embankment.